Student's Name _____ Date _____ Class _____

Student Sheet 1.1: KWL Chart

Topic: _____

K	W	L
What do you Know?	**What do you Want to Know?**	**What did you Learn?**

Student's Name _____ Date _____ Class _____

Student Sheet 3.1: Designing an Experiment (page 1 of 2)

What **resource** are you investigating? _____

What **question** about your resource are you investigating? _____

_____

What is your **hypothesis**? _____

_____

What is your **independent variable**? _____

_____

What is your **dependent variable**? _____

_____

What **materials** will you use? _____

_____

_____

_____

_____

What **procedure** will you follow? _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Student's Name _____ Date _____ Class _____

Student Sheet 3.1: Designing an Experiment (page 2 of 2)

What **data** will you collect? _____

Student's Name _____ Date _____ Class _____

Student Sheet 3.2: How Many Can an Ecosystem Sustain? (page 1 of 2)

Ecosystem A				
Generation	Initial Population	Number That Survive	Number of Offspring	Final Population
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				

Ecosystem B				
Generation	Initial Population	Number That Survive	Number of Offspring	Final Population
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				

Student's Name _____ Date _____ Class _____

Student Sheet 3.2: How Many Can an Ecosystem Sustain? (page 2 of 2)

Ecosystem C				
Generation	Initial Population	Number That Survive	Number of Offspring	Final Population
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				

Ecosystem D				
Generation	Initial Population	Number That Survive	Number of Offspring	Final Population
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				

Student's Name _____ Date _____ Class _____

Student Sheet 4.3: The Movement of Nitrogen

Starting Station	Cause of Transformation	Next Station

Student's Name _____ Date _____ Class _____

Student Sheet 6.2: Predation (page 1 of 2)

Table 1. Predator–Prey Data															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Initial Number of Mice															
Total Number of Mice Captured															
Number of Surviving Mice															
Number of Mice Offspring															
Initial Number of Barn Owls															
Number of Surviving Barn Owls															
Number of Barn Owl Offspring															
Number of Barn Owls for the Next Round															

Student's Name _____ Date _____ Class _____

Student Sheet 6.2: Predation (page 2 of 2)

Table 2. Predator Data

			OWL NUMBER													
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
ROUND	**1**	Number of Mice Captured															
		Number of Owl Offspring															
	2	Number of Mice Captured															
		Number of Owl Offspring															
	3	Number of Mice Captured															
		Number of Owl Offspring															
	4	Number of Mice Captured															
		Number of Owl Offspring															
	5	Number of Mice Captured															
		Number of Owl Offspring															
	6	Number of Mice Captured															
		Number of Owl Offspring															
	7	Number of Mice Captured															
		Number of Owl Offspring															
	8	Number of Mice Captured															
		Number of Owl Offspring															
	9	Number of Mice Captured															
		Number of Owl Offspring															
	10	Number of Mice Captured															
		Number of Owl Offspring															
	11	Number of Mice Captured															
		Number of Owl Offspring															
	12	Number of Mice Captured															
		Number of Owl Offspring															
	13	Number of Mice Captured															
		Number of Owl Offspring															
	14	Number of Mice Captured															
		Number of Owl Offspring															
	15	Number of Mice Captured															
		Number of Owl Offspring															

Student's Name _____ Date _____ Class _____

Student Sheet 7.3: Invasive Species

		Purple Squares	Blue Squares	Green Squares	Total Squares
Ecosystem Sheet 1	Quadrat 1				
	Quadrat 2				
	Quadrat 3				
	Total				
	Average Number / 4 cm^2				
	Average Number / 1 cm^2				
	Population Size				
Ecosystem Sheet 2	Quadrat 1				
	Quadrat 2				
	Quadrat 3				
	Total				
	Average Number / 4 cm^2				
	Average Number / 1 cm^2				
	Population Size				
Ecosystem Sheet 3	Quadrat 1				
	Quadrat 2				
	Quadrat 3				
	Total				
	Average Number / 4 cm^2				
	Average Number / 1 cm^2				
	Population Size				
Ecosystem Sheet 4	Quadrat 1				
	Quadrat 2				
	Quadrat 3				
	Total				
	Average Number / 4 cm^2				
	Average Number / 1 cm^2				
	Population Size				
Ecosystem Sheet 5	Quadrat 1				
	Quadrat 2				
	Quadrat 3				
	Total				
	Average Number / 4 cm^2				
	Average Number / 1 cm^2				
	Population Size				

Student's Name _____ Date _____ Class _____

Student Sheet 8.3: Coloration

Generation	Pompom Color	Initial Number	Number Captured	Number Remaining	Number of Offspring	Number for the Next Generation
1	Red					
	Blue					
2	Red					
	Blue					
3	Red					
	Blue					
4	Red					
	Blue					
	Yellow					
	White					
5	Red					
	Blue					
	Yellow					
	White					
6	Red					
	Blue					
	Yellow					
	White					
7	Red					
	Blue					
	Yellow					
	White					
8	Red					
	Blue					
	Yellow					
	White					

Student's Name _____ Date _____ Class _____

Student Sheet 9.1a: Measuring Biodiversity Group Data (page 1 of 2)

Activity 1

Table 1

	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5
0.0 cm					
0.5 cm					
1.0 cm					
1.5 cm					
2.0 cm					
2.5 cm					
3.0 cm					
3.5 cm					
4.0 cm					
4.5 cm					
5.0 cm					
5.5 cm					
6.0 cm					
6.5 cm					
7.0 cm					
7.5 cm					
8.0 cm					
8.5 cm					
9.0 cm					
9.5 cm					
10.0 cm					

Table 2

	Total	Percent Cover
Blue		
Red		
Green		
All Colors		

Activity 2

	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Total	Average / quadrat	Average / 1 cm^2	Estimated Population Size
Blue									
Red									
Green									

Student's Name _____ Date _____ Class _____

Student Sheet 9.1a: Measuring Biodiversity Group Data (page 2 of 2)

Activity 3

Number of marked individuals (red pompoms): _____

Sample Number	Number of Marked Beads in Sample	Total Number of Beads in Sample	% of Transect That Was Marked and Recaptured
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Average			

Estimated Population Size: _____

Activity 4

	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5
Number Caught					
Total Number Removed					

Original Population Size (x-intercept): _____

Student's Name _____ Date _____ Class _____

Student Sheet 9.1b: Measuring Biodiversity Class Data

Activity 1: Transects

Group		1	2	3	4	5	6	7	8	Class Average	Actual Number
Percent Cover	Red										
	Yellow										
	Blue										

Activity 2: Quadrats

Group		1	2	3	4	5	6	7	8	Class Average	Actual Number
Population Size	Red										
	Yellow										
	Blue										

Activity 3: Mark and Recapture

Group	1	2	3	4	5	6	7	8	Class Average	Actual Number
Population Size of White Pompoms										

Activity 4: Removal Sampling

Group	1	2	3	4	5	6	7	8	Class Average	Actual Number
Population Size of Yellow Pompoms										

Student's Name _____ Date _____ Class _____

Student Sheet: Credible Source Rubric

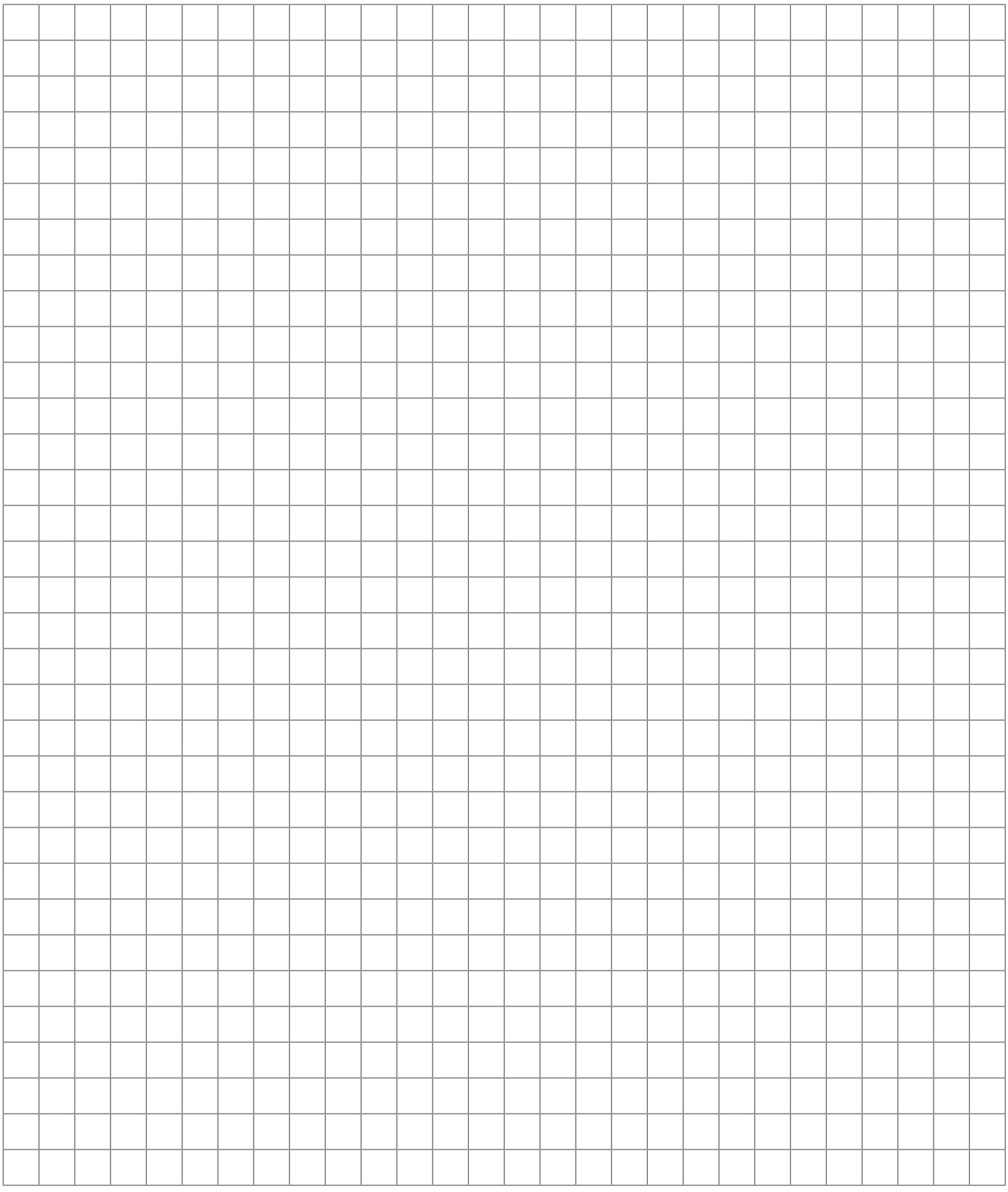
Directions: For each online source you use in your research, use the rubric to determine its credibility.

Criteria	3	2	1	Rating
Author	Author's name is easy to find. Author has previous knowledge and experience with the subject.	Author's name is not easy to find. Author may not have experience with the subject and uses common knowledge.	The author's name is unknown.	
Contact information	There is a clear and easy way to contact the author or organization responsible for the website.	It is difficult to find contact information for the author or organization responsible for the website.	There is no contact information available.	
Organization	This website is sponsored by a respectable, well-known organization. The sponsoring organization is clearly identified.	The website is sponsored by an organization that is not well known or is unrelated to the subject matter.	There is no clear sponsoring organization.	
Update frequency	The date of publication is clearly listed and the website is updated frequently.	The website has not been updated frequently and the article was published years ago.	There are no dates of publication or website updates.	
Factuality	The website is fact-based and appears to be free of opinion or bias.	The website appears factual, but the author has included some personal opinions.	The facts of this website are questionable and may be biased.	
Sources and citing	The author refers to and cites other sources to support the content.	The author refers to other sources, but does not provide citations or links.	The author does not provide the source of his or her information.	
Website purpose	The website exists to educate and inform.	The website exists to influence the audience to believe something.	The website exists to sell a product or for the author's personal gain.	

Is this website credible? Explain why or why not. _____

Student's Name _____ Date _____ Class _____

Student Sheet: Graph Paper



Student's Name _____ Date _____ Class _____

Student Sheet 11.WA: *Ecosystems and Their Interactions* Written Assessment Answer Sheet

Multiple Choice

1. _____ **3.** _____ **5.** _____

2. _____ **4.** _____ **6.** _____

Short Answer

7. _____

_____

_____

_____

8. _____

_____

_____

_____

9. a. _____

_____

_____

_____

b. _____

_____

_____

_____

c. _____

_____

_____

_____

Student's Name _____ Date _____ Class _____

Student Sheet 11.WA: *Ecosystems and Their Interactions* Written Assessment Answer Sheet
(page 2 of 3)

d. _____

_____

_____

_____

10. a. _____

_____

_____

_____

b. _____

_____

_____

_____

c. _____

_____

_____

_____

11. a.

Student's Name _____ Date _____ Class _____

Student Sheet 11.WA: *Ecosystems and Their Interactions* Written Assessment Answer Sheet

11. b. _____

c. _____

d. _____

12. a. _____

b. _____

c. _____

Station 1: Algae

Materials

- 6 Squares of Parafilm®
- 6 Test tubes in a large plastic cup
- 2 Medium plastic cups containing calcium chloride
- 1 Bottle of hydrogen carbonate indicator
- 1 Empty medium plastic cup labeled "Calcium chloride"
- 1 Graduated cylinder
- 1 Large plastic cup labeled "Syringe"
- 1 Piece of mesh
- 1 Plastic container labeled "Waste"
- 1 Plastic container of distilled water
- 1 Plastic spoon
- 1 Small plastic cup with sodium alginate and algae
- 1 Syringe
- Stopwatch or other timing device

Procedure

1. Use a permanent marker to label two test tubes "Algae."
2. Place one test tube into each of your two labeled large plastic cups.
3. Add 20 drops of hydrogen carbonate indicator solution to each test tube.
4. Use a graduated cylinder to measure 5 mL of distilled water. Add 5 mL of distilled water to each of your test tubes labeled "Algae."
5. Use your syringe to obtain 2 mL of sodium alginate and algae solution from the small plastic cup.
6. Place the cup of calcium chloride solution underneath the syringe. Hold the syringe 10–15 cm from the surface of the solution. Then, slowly press the plunger down so that the solution drips out of the tip of the syringe. Allow the solution of sodium alginate and algae to drip into the calcium chloride solution. It will form small spheres. Allow the spheres to remain in the calcium chloride solution for two minutes. Use your stopwatch to keep track of the time.
7. Repeat Steps 5–6, dropping the solution of sodium alginate and algae into the second cup of calcium chloride solution. You will have two cups containing calcium chloride and spheres. When you have finished with your syringe, return it to the large plastic cup at your station labeled "Syringe."
8. Place a piece of mesh on top of the empty medium cup labeled "Calcium chloride." Have one group member hold the mesh to ensure it does not fall into the container. Carefully pour the contents of one of the cups containing calcium chloride solution and the spheres through the mesh into the empty cup. The spheres should be caught by the mesh.
9. Move the mesh and spheres to the top of the large container labeled "Waste." Have one group member hold the mesh to ensure it does not fall into the container.
10. Rinse the spheres on the mesh by slowly pouring 10 mL of distilled water over them; the water should drain into the waste cup below and the spheres should remain on the mesh.
11. Use a spoon to place the spheres into one of the test tubes labeled "Algae."
12. Record the color of the solution in your test tube in your science notebook.
13. Repeat Steps 8–12 to place spheres in the other test tube labeled "Algae."
14. Cover each test tube with Parafilm. This creates a seal so that outside factors do not influence the experiment in the test tube.
15. When your teacher directs you to move to the next station, take your science notebook, permanent marker, and labeled plastic cups of test tubes with you.

Station 2: Yeast

Materials

- 6 Squares of Parafilm®
- 6 Test tubes in a large plastic cup
- 2 Medium plastic cups containing calcium chloride
- 1 Bottle of hydrogen carbonate indicator
- 1 Empty medium plastic cup labeled "Calcium chloride"
- 1 Graduated cylinder
- 1 Large plastic cup labeled "Syringe"
- 1 Piece of mesh
- 1 Plastic container labeled "Waste"
- 1 Plastic container of distilled water
- 1 Plastic spoon
- 1 Small plastic cup with sodium alginate and yeast
- 1 Syringe
- Stopwatch or other timing device

Procedure

1. Use a permanent marker to label two test tubes "Yeast."
2. Place one test tube into each of your two labeled large plastic cups.
3. Add 20 drops of hydrogen carbonate indicator solution to each test tube.
4. Use a graduated cylinder to measure 5 mL of distilled water. Add 5 mL of distilled water to each of your test tubes labeled "Yeast."
5. Use your syringe to obtain 2 mL of sodium alginate and yeast solution from the small plastic cup.
6. Place the cup of calcium chloride solution underneath the syringe. Hold the syringe 10–15 cm from the surface of the solution. Then, slowly press the plunger down so that the solution drips out of the tip of the syringe. Allow the solution of sodium alginate and yeast to drip into the calcium chloride solution. It will form small spheres. Allow the spheres to remain in the calcium chloride solution for two minutes. Use your stopwatch to keep track of the time.
7. Repeat Steps 5–6, dropping the solution of sodium alginate and yeast into the second cup of calcium chloride solution. You will have two cups containing calcium chloride and spheres. When you have finished with your syringe, return it to the large plastic cup at your station labeled "Syringe."
8. Place a piece of mesh on top of the empty medium cup labeled "Calcium chloride." Have one group member hold the mesh to ensure it does not fall into the container. Carefully pour the contents of one of the cups containing calcium chloride solution and the spheres through the mesh into the empty cup. The spheres should be caught by the mesh.
9. Move the mesh and spheres to the top of the large container labeled "Waste." Have one group member hold the mesh to ensure it does not fall into the container.
10. Rinse the spheres on the mesh by slowly pouring 10 mL of distilled water over them; the water should drain into the waste cup below and the spheres should remain on the mesh.
11. Use a spoon to place the spheres into one of the test tubes labeled "Yeast."
12. Record the color of the solution in your test tube in your science notebook.
13. Repeat Steps 8–12 to place spheres in the other test tube labeled "Yeast."
14. Cover each test tube with Parafilm. This creates a seal so that outside factors do not influence the experiment in the test tube.
15. When your teacher directs you to move to the next station, take your science notebook, permanent marker, and labeled plastic cups of test tubes with you.

Station 3: Distilled Water

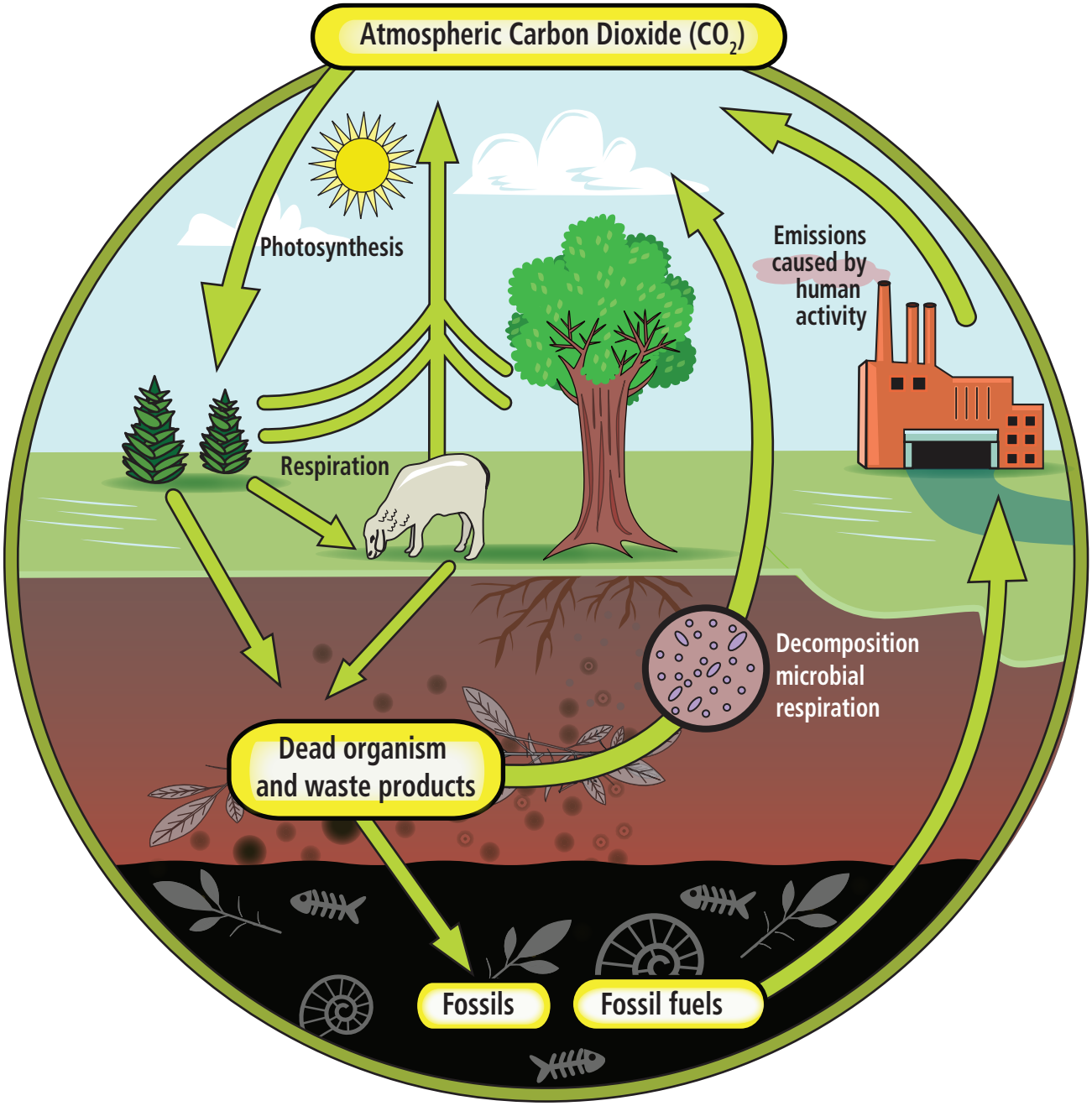
Materials

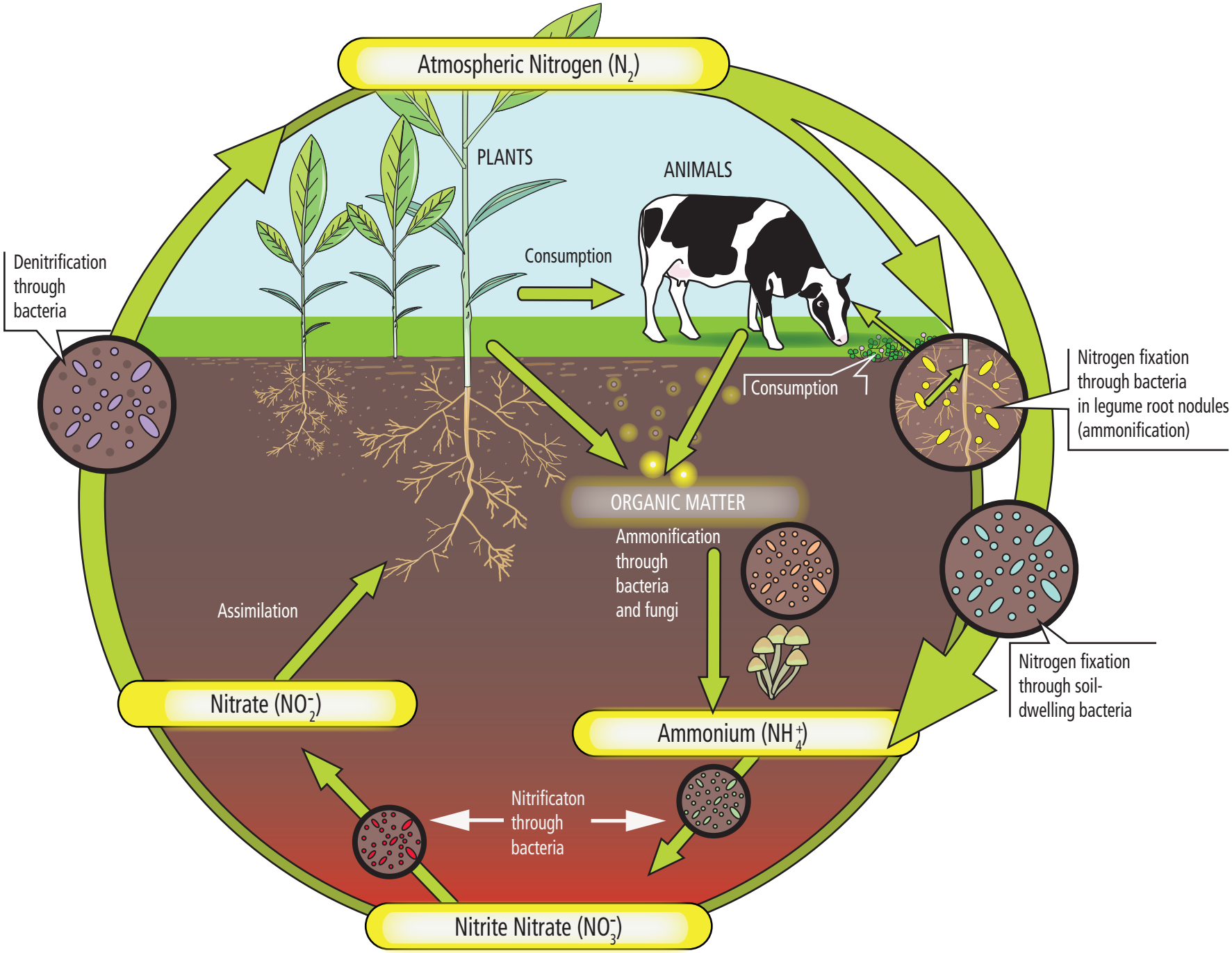
- 6 Squares of Parafilm®
- 6 Test tubes in a large plastic cup
- 2 Medium plastic cups containing calcium chloride
- 1 Bottle of hydrogen carbonate indicator
- 1 Empty medium plastic cup labeled "Calcium chloride"
- 1 Graduated cylinder
- 1 Large plastic cup labeled "Syringe"
- 1 Piece of mesh
- 1 Plastic container labeled "Waste"
- 1 Plastic container of distilled water
- 1 Plastic spoon
- 1 Small plastic cup with sodium alginate and distilled water
- 1 Syringe
- Stopwatch or other timing device

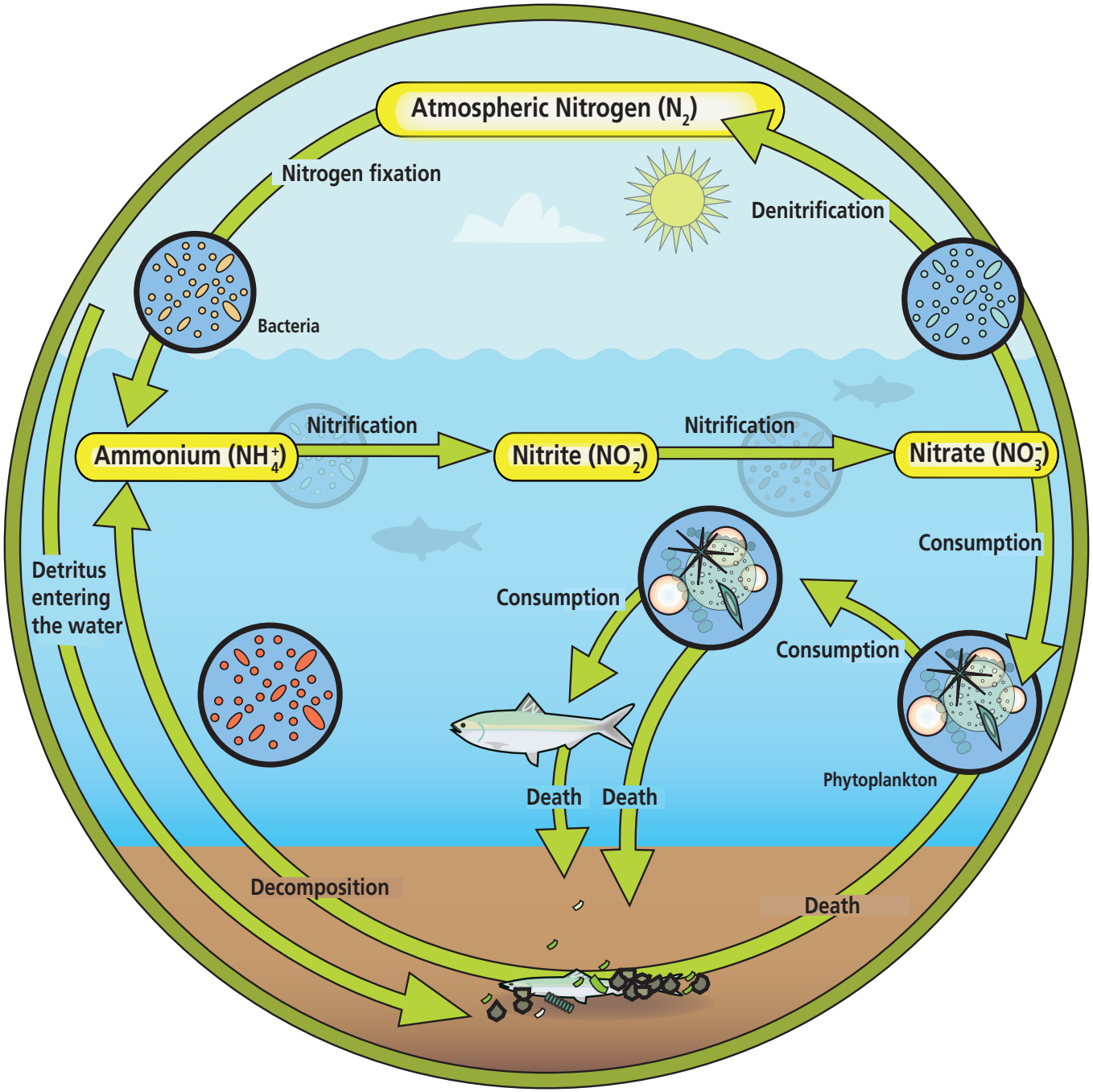
Procedure

1. Use a permanent marker to label two test tubes "Distilled Water."
2. Place one test tube into each of your two labeled large plastic cups.
3. Add 20 drops of hydrogen carbonate indicator solution to each test tube.
4. Use a graduated cylinder to measure 5 mL of distilled water. Add 5 mL of distilled water to each of your test tubes labeled "Distilled Water."
5. Use your syringe to obtain 2 mL of sodium alginate and distilled water solution from the small plastic cup.
6. Place the cup of calcium chloride solution underneath the syringe. Hold the syringe 10–15 cm from the surface of the solution. Then, slowly press the plunger down so that the solution drips out of the tip of the syringe. Allow the solution of sodium alginate and distilled water to drip into the calcium chloride solution. It will form small spheres. Allow the spheres to remain in the calcium chloride solution for two minutes. Use your stopwatch to keep track of the time.
7. Repeat Steps 5–6, dropping the solution of sodium alginate and distilled water into the second cup of calcium chloride solution. You will have two cups containing calcium chloride and spheres. When you have finished with your syringe, return it to the large plastic cup at your station labeled "Syringe."
8. Place a piece of mesh on top of the empty medium cup labeled "Calcium chloride." Have one group member hold the mesh to ensure it does not fall into the container. Carefully pour the contents of one of the cups containing calcium chloride solution and the spheres through the mesh into the empty cup. The spheres should be caught by the mesh.
9. Move the mesh and spheres to the top of the large container labeled "Waste." Have one group member hold the mesh to ensure it does not fall into the container.
10. Rinse the spheres on the mesh by slowly pouring 10 mL of distilled water over them; the water should drain into the waste cup below and the spheres should remain on the mesh.
11. Use a spoon to place the spheres into one of the test tubes labeled "Distilled Water."
12. Record the color of the solution in your test tube in your science notebook.
13. Repeat Steps 8–12 to place spheres in the other test tube labeled "Distilled Water."
14. Cover each test tube with Parafilm. This creates a seal so that outside factors do not influence the experiment in the test tube.
15. When your teacher directs you to move to the next station, take your science notebook, permanent marker, and labeled plastic cups of test tubes with you.

Lesson Master 4.2b: Movement of Carbon Diagram






Atmospheric Nitrogen (N_2)
Nitrogen fixation
Denitrification
Bacteria
Nitrification
Nitrification
Ammonium (NH_4^+)
Nitrite (NO_2^-)
Nitrate (NO_3^-)
Consumption
Detritus entering the water
Consumption
Consumption
Phytoplankton
Death
Death
Decomposition
Death

BUILDING YOUR KNOWLEDGE *READING SELECTION*

A Trip Through Africa

DAY 1

We drove for hours from Johannesburg, South Africa, to a lodge outside Kruger National Park. As we got closer to the lodge, we spotted our first animals in the distance. A group of zebras, which our driver called a harem, were grazing on the tall grasses that are plentiful in the area.

We arrived at the lodge near dinnertime and unpacked for our adventure. During dinner, we met the other guests at the lodge and learned a little history of the park and the wildlife that can be found within it. After dinner, our guides took us on a night safari ride through a reserve. We all loaded into what looked like a giant SUV with no doors, windows, or roof. The safari vehicle had only three rows of bench seats open to the night air. Once we were all seated, our driver took off at dusk with the cool air whipping across our faces. On the drive, we saw many eyes glowing back at us as our driver shined a spotlight into the darkness. We observed several different species of antelope that are common in this area, but the spotlight scared most of them away before we could identify them.

As we were riding, our guide received confirmation that three lionesses had been spotted stalking and killing an impala, a species of antelope. The driver immediately went to the area to observe this interaction.

Volodymyr Burdiak/Shutterstock.com

Zebras grazing

creativex/Shutterstock.com

Lioness and cub eating

As our guide shined a spotlight, we noticed that the large cats were not feeding. Instead, eight small lion cubs were enjoying dinner thanks to the hard work of their mothers. We sat close enough to observe the feeding and these beautiful animals for quite some time. At one point, a lioness walked right by our vehicle. She could have easily attacked us since the vehicle offered no protection, but instead, she sat with the cubs and monitored their feeding.

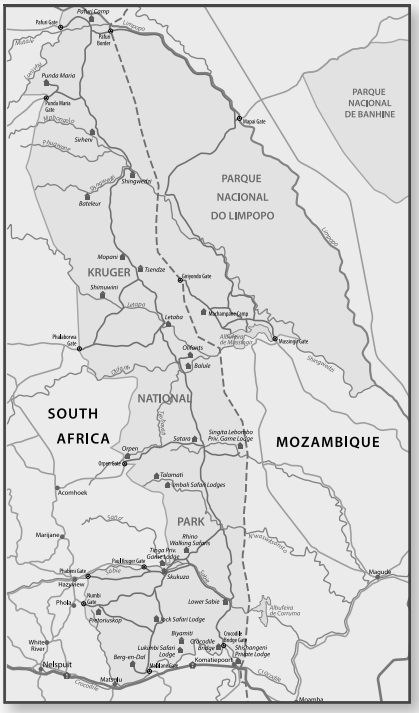
With all the excitement of this evening's events, and the rare chance to observe lionesses and their cubs, I cannot wait to see what else this safari adventure will bring!

DAY 2

We woke up bright and early to head out to Kruger National Park. As I read the welcome brochure, I learned just how massive the park is. Kruger covers over 19,500 km^2 (7,500 mi^2) in South Africa, so it is larger than the state of Connecticut!

At the beginning of the safari, our guide explained that we would see many different types of organisms, but that we should be on the lookout for Africa's Big Five, which include the African lion, African elephant, Cape buffalo, leopard, and rhinoceros. He explained that the Big Five category was created by hunters who considered these animals to be the largest and most dangerous animals to hunt on foot. Today, all animals are protected in the park, and the only shooting that happens is with a camera.

The first animal we observed on our drive was the tallest land animal, the giraffe. We watched six of them for a long time. Their long necks moved gracefully as they pulled leaves off trees. Our guide explained that a group of giraffes is called a tower and that these animals primarily



Map of Kruger National Park

Rainer Lesniewski/Shutterstock.com

Papa Bravo/Shutterstock.com

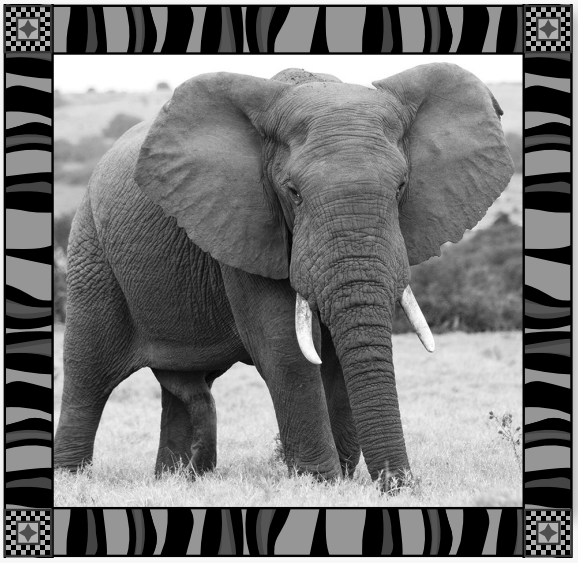
Impala

eat leaves but also enjoy fruits when they are in season. Nearby, a herd of impalas grazed on the plentiful grasses.

As we drove on, we came across a lone male elephant, known as a bull. He paid no attention to us and continued to rip apart a shrub with his trunk. While we observed the massive animal eat, I noticed insects on the shrubs. Some insects were consuming the nectar from the shrubs' small flowers, while others were munching on the shrubs' leaves. When I pointed out the insects to the guide, he explained that different species of insects have particular diets. Some get their energy from different parts of the shrub like the flowers and leaves. Other insects prefer parts of a certain tree or grass, or they enjoy eating the many fruits that the region produces.

After lunch, we observed a variety of small birds in many colors and designs. Some species were eating grasses and fruits. Others seemed to prefer the many insects that could be found around the area. We also saw herds of several species of animals, including wildebeest, grazing on the plentiful grasses. Zebras seem to be around each corner, and we startled a group of warthogs that scurried away as we passed.

My favorite part of the day was when our guide noticed a larger animal in the distance. We had to remain in our safari vehicle for safety, which made it difficult to see what was going on. I got my binoculars out of my pack and observed a doglike animal feeding on a dead springbok. Our guide explained that this animal was a jackal. Jackals hunt and kill small birds



markdescande/Shutterstock.com

African bush elephant

ArCalu/Shutterstock.com

Blue-backed jackal

and small mammals, such as the rock hyrax, and they even work together to kill impalas. They are primarily scavengers, though, and will even try to steal another animal's kill.

DAY 3

We were up before the Sun came out to prepare for a morning hike through the reserve. At →

dawn, we set out toward the river in hopes of seeing some hippopotamuses. Along the way, we observed firsthand the vegetation common to this part of Africa. The grasses, which so many animals rely on as a primary food source, were tall and dry. The grasses were gently swaying in the faint breeze and soaking up the sunlight. We startled a springbok that was grazing as we made our way to the river. Our guide pointed out a variety of trees, including acacia trees, that are common in South Africa. Apparently, giraffes, elephants, impalas, zebras, and even insects enjoy different parts of these trees as part of their diet.

As we continued, we walked near the area where the lionesses killed the impala on our first night's safari. The lions no longer were there, but we could see a couple of large birds. I reached for my binoculars to take a closer look and saw what a guide called a white-backed vulture. These endangered birds are the most common type of vulture in Africa. They are scavengers and use their slightly curved beaks to feed on the bodies of any large mammal, from a springbok to an elephant!

As we approached the river, we saw large bumps that looked like rocks. They were the same color as the river water. We saw more of these bumps foraging on the grassy banks next to the river. These large bumps were hippos! More than 40 of them were sitting in the water and at least 8 more were on the bank. We sat down on a large rock, observing the animals as we ate our breakfast. Our guide explained that these large mammals spend up to 16 hours each day in the water to keep cool in the hot African Sun. As we ate, so did some of the hippos. Apparently, these massive animals eat up to 35 kg (85 lbs) of grass and other

Graeme Shannon/Shutterstock.com

Acacia tree

EcoPrint/Shutterstock.com

White-backed vulture

Serge Vero/Shutterstock.com

Hippos grazing

plant material per day. Most of this food is consumed at night when they come out of the water. Hippopotamuses can be very aggressive, so we did not get very close.

As we walked back to the lodge, we saw many kinds of birds and insects—too many kinds to name! Our guide stopped us to point out fruit on the ground from a marula tree. He explained that these fruits are a favorite food source for elephants, giraffes, rhinos, and kudus (another type of antelope). The animals even help the tree reproduce by eating the whole fruit and dispersing its seeds farther away from the parent plant when they defecate. Speaking of waste, we witnessed a couple of dung beetles on the walk. Just like their name suggests, these animals feast on animal feces, primarily from animals that eat plants. Our guide explained that a male and female beetle will work together to create a ball of dung much larger than themselves—up to 50 times their weight. Then, the male will use its back legs to roll the dung ball to a safe location where it can be buried and then munched on in the future. Meanwhile, the female hitches a ride! The beetles have to be careful while on the move. Small birds, rock hyraxes, warthogs, and even jackals will not hesitate to make a snack of them.

After we returned to the lodge, we hopped in our safari vehicle and headed to a new area of Kruger. Our afternoon trip was short but eventful. We started off observing one male and two female lions lounging on rocks. We learned that the females do the bulk of their hunting at night and work together to hunt and kill animals that are much larger than they are. The lions' diet consists of animals such as zebras, kudus, Cape buffaloes, springboks, impalas, wildebeests, giraffes, and elephants.

On this ride, there were numerous herbivore sightings, including a small herd of kudus that were pulling leaves off shrubs and trees and an elephant that was walking down the road in front of us. We even witnessed a group of warthogs dashing across the road to a watering hole. A woman in our group said she saw warthogs dining on a variety of grasses and fruits while on a different safari the previous day. Our guide explained that

MartinMaritz/Shutterstock.com

Dung beetles

john michael evan potter/Shutterstock.com

Kudu

PhotocechCZ/Shutterstock.com

Zebras and wildebeests

warthogs also eat many types of local insects.

We observed a massive group of zebras and wildebeests dining together on leaves from various shrubs. Apparently, these animals have developed a social relationship that aids in both groups' survival. Zebras have excellent eyesight, and wildebeests have excellent hearing. Grazing together, these groups can alert each another when a predator, such as a leopard, approaches. Leopards are smaller in size than lions and hunt alone, but they can attack and kill wildebeests and young zebras.

As we finished up for the day, I reflected on the many animals we had observed thus far on the trip. Out of the Big Five, we had spotted only elephants and lions. The Cape buffaloes, leopards, and rhinoceroses still eluded us. Hopefully, we will have more success in our final two days.

DAY 4

At breakfast this morning, I was surprised to see a monkey eating out of the fruit bowl on the buffet table. As I squeaked and pointed, the hostess laughed and told me it was a vervet monkey. Apparently, they are known for sneaking onto patios and stealing fruit. In the wild, though, they eat a variety of foods, including insects, fruits, and leaves from different trees and shrubs.

After breakfast, we headed out to visit a rehabilitation center for abandoned and injured animals. Many of the staff at the center are volunteers who donate their time to help nurse the animals back to health in the hopes of the releasing them back into the wild. If an animal is unable to return, it becomes a permanent resident of the center.

At the center, we met two cheetahs that suffered from permanent leg injuries. These injuries prevented them from being able to successfully hunt animals such as warthogs, springboks, and impalas, so they are permanent residents of the center. We also observed a hyena, a small African cat called a serval, and more lions. My favorite exhibit housed a pack of endangered African

Francois van Heerden/Shutterstock.com

African wild dog

wild dogs. As I read about this species, I learned that they have four toes instead of the typical five on their forefeet; large, rounded ears; and unique coat colors. They are very social animals and hunt in packs to bring down larger animals such as impalas, kudus, and wildebeests. They also hunt smaller animals such as rock hyraxes.

After leaving the rehabilitation center, we went for an afternoon safari drive. We saw some of the common herbivores grazing: impalas, kudus, zebras, giraffes, springboks, and wildebeests. We watched an adorable animal called a rock hyrax survey the land from atop a rock. We assumed he was looking for predators before heading out to find food. Our guide explained that rock hyraxes are omnivores that eat grasses, fruit, and insects. We also observed crocodiles basking in the hot Sun along the banks of a river. I asked if crocodiles ever hunted hippos, and our guide explained that crocodiles eat baby hippos as well as other animals that come to the river to drink, including

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White rhinoceros

Cape buffaloes, impalas, springboks, wildebeests, zebras, and vervet monkeys.

The highlight of this safari ride was a group of rhinoceroses in the distance. They appeared to be grazing on the grasses and shrubs. We spent a great deal of time watching them through binoculars. I wish we could have moved closer, but I was excited that we were able to spot these elusive animals in their natural habitat.

After we returned to the lodge, I talked with a different guide about my experiences in Kruger so far. He asked if we had seen all of

Yakov Oskanov/Shutterstock.com

Rock hyrax

matthieu Gallet/Shutterstock.com

Cape buffalo

the Big Five animals. I explained that the Cape buffalo and the leopard continued to elude us. To my surprise, he told me that a herd of Cape buffalo was grazing just past the lodge's fence. We hopped in his truck and drove for only two minutes before we reached the herd. We watched them for a short time in the evening light, grazing on grasses. On the ride back, I thanked him for taking the time to drive me to the fence to witness another of the Big Five. I can now officially say that I have spotted four of the Big Five African animals! I have one day left to spot the extremely elusive leopard.

DAY 5

On our final safari, we spent the entire day exploring Kruger National Park. First thing, we encountered a traffic jam of SUVs and safari vehicles. As I looked around, I spotted three hyenas just off the road. One was lying down, and the other two were nervously pacing. They made the most eerie sound when they communicated with each other. It was like a high-pitched laugh that sent chills down my spine. We could not figure out why they were so close to our vehicles and not scampering off. Then, a guide in another vehicle pointed to a tree. Taking out my binoculars, I could not believe what I saw: a leopard! Not just a leopard, but a leopard in a tree with a fresh kill—an impala—dangling from the branches. I remembered reading that African leopards are the smallest of the large cats but are the strongest climbers. Lions and hyenas steal their prey if given the opportunity, so leopards will drag their heavy prey up a tree for safekeeping. Leopards have been known to drag impalas, springboks, and warthogs into trees. They also prey on smaller animals such as rock hyraxes and birds. I could not believe that I had just seen the final animal in the Big Five!

The hyenas, being opportunity scavengers, wanted that impala but could not climb the tree. According to our guide, hyenas hunt smaller prey such as rock hyraxes and birds by themselves.

Efimova Anna/Shutterstock.com

Leopard with its kill

gualtiero boffi/Shutterstock.com

Hyena

They also hunt larger animals such as wildebeests, impalas, warthogs, and springboks by working as a group. However, scavenging allows them to exert less energy, and they will not pass up a free meal. Hyenas will scavenge off the bodies of most of the large animals found in Kruger.

After spending a great deal of time watching the leopard feed and the hyenas circle the tree, we eventually made our way to other parts of the park. Throughout the day, we spotted many colorful birds, large herds of impalas grazing on grasses, a lone male kudu munching some grass, and a great number of giraffes. A parade of elephants crossed our path at one point. We watched a group of females and a calf make their way along a worn path in the brush to a watering hole. On our way back to the lodge, we passed the tree where the leopard had been, but it was gone. The hyenas were still circling the tree trying to figure out how to scavenge the rest of the impala, which was still high up in the tree.

As our final day in Kruger National Park came to an end, I reflected on all of the amazing plant and animal life that this ecosystem offers. The park is home to the largest and tallest land animals on the planet. The vast, grassy land allows numerous herbivores to graze and attracts unique and ferocious carnivores that feed on those herbivores. What a complex and diverse system this ecosystem is! On the final stretch of road, I looked out along the horizon to view a final African sunset gleaming through the acacia trees.

African sunset

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Lesson Master 7.1: Pond Testing

1. Examine your pond (experimental or control), and record your observations in your science notebook.

2. Use your thermometer to measure the temperature of your pond. Take the temperature both at the bottom and at the surface of your pond. Record your temperature readings in the table in your science notebook.

3. Use a pipet to take samples of your pond in different locations. As with your large pond, you will want to decide where to take samples in your pond. You may take up to four samples as there are enough materials for you to make four wet-mount slides. You should continue to take samples from these locations as you monitor your pond. Examine the contents of your pipet. Record any observations in your science notebook.

4. Make a wet-mount slide using the water in your pipet. Record any observations in your science notebook.

5. Repeat Steps 3–4 for each sample that you take of your pond.

6. Fill the plastic cup with water from your pond. You will use this water to perform the water quality tests.

7. Follow the instructions on the provided cards to conduct your water quality tests. Record your results in the table in your science notebook.

8. Return any unused water from your cup to your sample pond.

9. Add spring water to raise the level of your pond and replace the water lost to testing.

10. Follow your teacher's instructions to clean up your lab area. Then, thoroughly wash your hands with soap and water.

Lesson Master 11.PA: *Ecosystems and Their Interactions* Performance Assessment Scoring Rubric (page 1 of 2)

		Exemplary	Proficient	Developing	Beginning
Obtaining Information	Ecosystem Service	Student has thoroughly gathered information on an assigned ecosystem service.	Student has gathered information on an assigned ecosystem service.	Student has partially gathered information on an assigned ecosystem service.	Student has not gathered information on an assigned ecosystem service.
	Threats to Ecosystem Service	Student has thoroughly gathered information on threats to the ecosystem service.	Student has gathered information on threats to the ecosystem service.	Student has partially gathered information on threats to the ecosystem service.	Student has not gathered information on threats to the ecosystem service.
	Existing Solutions	Student has thoroughly gathered information on existing solutions to a threat to the ecosystem service.	Student has gathered information on existing solutions to a threat to the ecosystem service.	Student has partially gathered information on existing solutions to a threat to the ecosystem service.	Student has not gathered information on existing solutions to a threat to the ecosystem service.
Criteria and Constraints		Student has thoroughly described their criteria and constraints from their stakeholders' point of view.	Student has described their criteria and constraints from their stakeholders' point of view.	Student has partially described their criteria and constraints from their stakeholders' point of view.	Student has not described their criteria and constraints from their stakeholders' point of view.
Plan Description		Student has thoroughly described their plan for a solution to the threat to their ecosystem service.	Student has described their plan for a solution to the threat to their ecosystem service.	Student has partially described their plan for a solution to the threat to their ecosystem service.	Student has not described their plan for a solution to the threat to their ecosystem service.
Plan Explanation		Student has thoroughly explained their plan for a solution to the threat to their ecosystem service.	Student has explained their plan for a solution to the threat to their ecosystem service.	Student has partially explained their plan for a solution to the threat to their ecosystem service.	Student has not explained their plan for a solution to the threat to their ecosystem service.
Poster Design		Poster was designed so that the necessary information can be obtained and is able to be understood without a presentation.	Poster was designed so that most of the necessary information can be obtained and is able to be fully understood without a presentation.	Poster was designed so that some of the necessary information can be obtained and understood without a presentation.	Poster was designed so that the necessary information cannot be obtained and understood without a presentation.
Poster Layout		Poster layout was relevant and effective for the presentation of information.	Poster layout was relevant and partially effective for the presentation of information.	Poster layout was relevant for the presentation of information.	Poster layout was not relevant for the presentation of information.

continued

Lesson Master 11.PA: *Ecosystems and Their Interactions* Performance Assessment Scoring Rubric (page 2 of 2)

	Exemplary	Proficient	Developing	Beginning
Poster Images	Images were relevant and captioned appropriately.	Images were relevant but were not captioned appropriately.	Images were not relevant but were captioned appropriately.	Images were not present or were not relevant and not captioned appropriately.
Presentation	Presentation was well organized and informative.	Presentation was fairly organized and informative.	Presentation was disorganized but informative.	Presentation was not informative.
Sources	Student has used three or more credible sources of information for investigating their topics.	Student has used three or more sources of information for investigating their topics, but only some are credible. OR Student has used fewer than three resources and all resources were credible.	Student has used three or more sources of information for investigating their topics, but they are not credible.	Student has not used three or more sources of information for investigating their topics.